Removal of Common Carp, Longnose Sucker and White Sucker from Blacktail Meadows Kids Fishing Pond

Environmental Assessment

8/31/2020

Montana Fish, Wildlife & Parks
Region 3 Office
1400 South 19th Avenue
Bozeman, MT 59718

MONTANA FISH, WILDLIFE & PARKS

Executive Summary

Blacktail Meadows Kids Pond was created to provide a convenient place that offers good trout fishing year-round for youth anglers 12 years old and younger in Dillon, Montana (Figure 1). Every year this groundwater-fed pond is stocked multiple times with hatchery Rainbow Trout and Westslope Cutthroat Trout (WCT). An overflow event caused by beaver dams in nearby Pigtail Slough allowed less desirable Common Carp (CC), Longnose Sucker (LN SU), and White Sucker (W SU) to invade and become established within the Kids Pond. These three species have been sampled and documented periodically since 2008 and are plentiful and stunted in size. The stunting is indicative of a lack of food availability and suggests the pond cannot support good growth for hatchery trout due to competition with nongame fish. The amount of nongame fish biomass also reduces the number of trout that the pond can support. Over the last several years, reports of dead trout have been common, and it is believed that some of this may be caused by the lack of food. Moreover, the benthic foraging habits of CC, LN SU, and W SU have increased pond turbidity year-round, significantly diminishing the quality of the trout fishery.

FWP proposes to remove CC, LN SU, and W SU from Blacktail Meadows Kids Pond by treating the pond with rotenone in October 2020. Diesel pumps would be used to dewater the pond into the adjacent Pigtail Slough. Once the pond is reduced to a small pool (~0.25 acre-feet), it would be treated with liquid rotenone. The pond would be restocked with hatchery trout the following spring. Removal of nongame fish will increase the productivity of the pond, provide more food for trout, and offer a better fishing opportunity for the youth of the local community. Blacktail Meadows Kids Pond has a surface area of 2.1 acres, maximum depth of 12.5 feet, mean depth of 5.4 feet, and a volume of 10.6 acre-feet (Figure 2).

Environmental Assessments (EA) are a requirement of the Montana Environmental Policy Act (MEPA), which requires state agencies to consider the environmental, social, cultural, and economic effects of proposed actions. This EA considers potential consequences of three alternatives to improve the fishery in Blacktail Meadows Kids Pond. Physical suppression was considered but was removed from consideration because it is not a long-term solution to the problem, it would require annual effort, and the nongame species would not be eradicated but would remain in low numbers. Finally, physical suppression is very labor intensive and therefore expensive. The three alternatives considered are:

1. Alternative 1 (Preferred): Removing nongame Common Carp, Longnose Sucker, and White Sucker from Blacktail Meadows Kids Pond with rotenone.
2. Alternative 2: No action
3. Alternative 3: Physical suppression with the use of trap nets.

Alternative 1 is the preferred alternative. It would have short-term, minor effects on fish, recreation, and vegetation. This alternative would allow the purpose of Blacktail Meadows Kids Pond to be achieved by providing a high-quality youth only trout fishery.

MEPA requires public involvement and opportunity for the public to comment on projects undertaken by the act's respective agencies. A public comment period will extend from August 31 through September 30. A public meeting will be held in Dillon on September 3, 2020, at the Search and Rescue Building, beginning at 6:00 pm or via an online platform if necessitated by COVID restrictions. Interested parties should send comments to:

Montana Fish, Wildlife & Parks – Region 3

c/o Blacktail Meadows Kids Pond Nongame Fish Removal

1400 S. 19th Ave. Bozeman, MT 59718

Email: fwprg3ea@mt.gov

1 Table of Contents

List of Abbreviations

ARM	Administrative Rules of Montana
DEGEE	diethyl glycol monoethyl ether
DEQ	Montana Department of Environmental Quality
EA	Environmental Assessment
EPT	Ephemeroptera, Plecoptera, Trichoptera (mayflies, stone flies, & caddis flies)
FS	Forest Service
FWP	Montana Fish, Wildlife & Parks
$KMnO_4$	potassium permanganate
MCA	Montana Code Annotated
MEPA	Montana Environmental Policy Act
MNHP	Montana Natural Heritage Program
MOU	Memorandum of understanding
MSDS	Material data safety data sheet
USEPA	United States Environmental Protection Agency

2 PROPOSED ACTION and BACKGROUND

2.1 *Type of Proposed Action*

Removal of non-game fish species with rotenone to improve water clarity and angling quality in the Blacktail Meadows Kids Pond.

2.2 *Agency Authority for the Proposed Action*

Montana state law provides FWP with the fish management authority and restoration projects (MCA § 87-1-702; § 87-1-201[9][a]). In waters where FWP is seeking to remove or control unauthorized species, FWP must endeavor to protect the previously existing fishery and suppress or eradicate the unauthorized species to maintain the existing management objectives for that fishery (ARM 12. 7. 1501[4]). Montana state law also allows the use of chemicals to remove fish (ARM 12. 7. 1503[1][f][ii]).

Planning documents and strategies developed by agencies and collaborating entities also provide official justification for the proposed project (Table 1). These include agreements among stakeholder groups, state and federal laws, and agency plans designed to maintain certain fisheries (i.e., provide good angling opportunity for youth (12 and under) across the state by maintaining local kids' fishing ponds) and managing them as urban fisheries.

Table 1. Planning and strategy documents with relevance to Blacktail Meadows Kids Pond.

Agency	*Citation*	*Website*
FWP	Statewide Fisheries Management Plan (2014)	http://fwp. mt. gov/fishAndWildlife/management/fisheries/statewidePlan/
FWP	Piscicide Policy (2017)	Internal document

2.3 *Estimated Commencement Date*

The estimated commencement date is October 2020.

2.4 *Name and Location of the Project*

Removal of Common Carp, Longnose Sucker and White Sucker from Blacktail Meadows Kids Fishing Pond with Rotenone

Blacktail Meadows Kids Pond is in the Beaverhead watershed which joins the Big Hole River to form the Jefferson River near Twin Bridges, MT. The project is in Beaverhead County, located directly off Interstate 15 Exit 63 on Montana Fish, Wildlife & Parks land as you enter Dillon, Montana (Figure 1). The legal description is Township 7S, Range 9W, section 18.

Figure 1. Map of project area. Blacktail Meadows Kids Pond is located adjacent to Interstate 15 exit 63 as you enter Dillon, MT.

2.5 *Project Size (Affected Area)*

1.	Developed/residential	0 acres
2.	Industrial	0 acres
3.	Open space/woodland/recreation	0 acres

4.	Wetlands/riparian areas	2.1 acres
5.	Floodplain	0 acres
6.	Irrigated cropland	0 acres
7.	Dry cropland	0 acres
8.	Forestry	0 acres
9.	Rangeland	0 acres

Blacktail Meadow Kids Pond has a surface area of 2.1 acres at full pool. Its maximum depth is 12.5 feet, the mean depth is 5.4 feet, and the pond is 10.6 acre-feet in volume (Figure 2). There is no inlet or outlet, and the water source is groundwater.

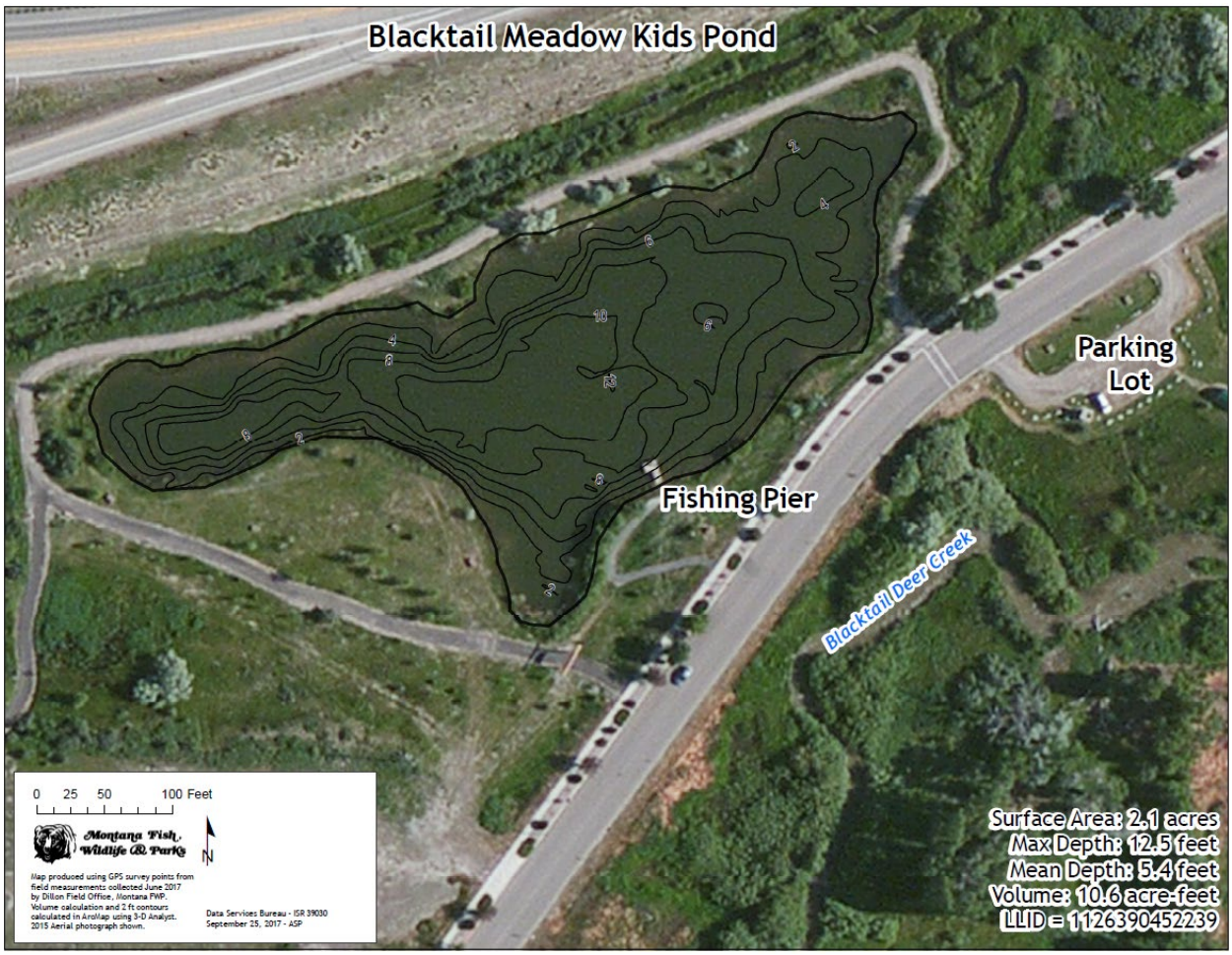

Figure 2. Bathymetry of Blacktail Meadow Kids Pond.

2.6 *Narrative Summary of the Proposed Action and the Purpose of the Proposed Action*

2.6.1 Summary and Background

Montana Fish, Wildlife & Parks is proposing to remove nongame fish species within the Blacktail Meadow Kids Pond with rotenone in October 2020. The goal of this project is to improve angling opportunity, increase trout numbers, and improve water clarity by removing Common Carp (CC), Longnose Sucker (LN SU), and White Sucker (W SU) populations that persist within the pond. These are the targeted species, however all fish within the pond will be removed. After the treatment is completed, the pond will be restocked with hatchery trout the following spring.

The Kids Pond was created for and is managed as a put and take trout fishery to provide year-round angling opportunity for kids 12 and under. An overflow event caused by beaver dams in nearby Pigtail Slough allowed less desirable CC, LN SU, W SU to become established within the Kids Pond. With the unintentional addition of nongame fish populations, the pond has become less productive for hatchery planted trout and the water is turbid throughout the year. Trap nets surveys indicate the nongame fish species are over abundant and in poor condition; the Kid's Pond is small (2.1 acres), and there is not enough food to support high biomass of nongame fish along with hatchery trout. Trout have experienced die-offs the past few years, which may be attributed to competition and starvation among other factors.

Once the pond is restored to a trout fishery, it will continue to be stocked multiple times annually to create a high-quality angling opportunity for the youth community of Dillon, Montana.

Method of Fish Removal

Rotenone would be used to remove non-native fish from Blacktail Pond. Rotenone is a naturally occurring substance derived from the roots of tropical plants in the bean family such as the jewel vine (*Derris* spp.) and lacepod (*Lonchocarpus* spp.) that are found in Australia, Oceania, southern Asia, and South America. Rotenone has been used by native people for centuries to capture fish for food in areas where these plants are naturally found. It has been used in fisheries management in North America since the 1930s.

2.6.2 How Does It Work?

Rotenone is applied to the water and enters fish through the gills. It is effective at very low concentrations with gill-breathing organisms because it is readily absorbed into the bloodstream through the thin cell layer of the gills. Mammals, birds, and other non-gill breathing organisms do not have this rapid absorption route into the bloodstream and are not affected by consuming treated water or dead fish at concentrations used in fisheries management. Rotenone kills fish by interrupting the Krebs Cycle in individual cells.

2.6.3 Treatment Area

Rotenone would be applied to Blacktail Meadow Kids Pond; however, the pond would be drained down to less than 0.25 acre-feet with diesel pumps prior to treatment (Figure 3). Reducing pond volume minimizes the amount of rotenone used while maximizing the

effectiveness of the treatment. Additionally, the rotenone would be deactivated through dilution (< 2 ppb) as the pond naturally refills with groundwater. If refilling of the pond is unlikely to occur before ice cover, it will be actively detoxified using potassium permanganate ($KMnO_4$).

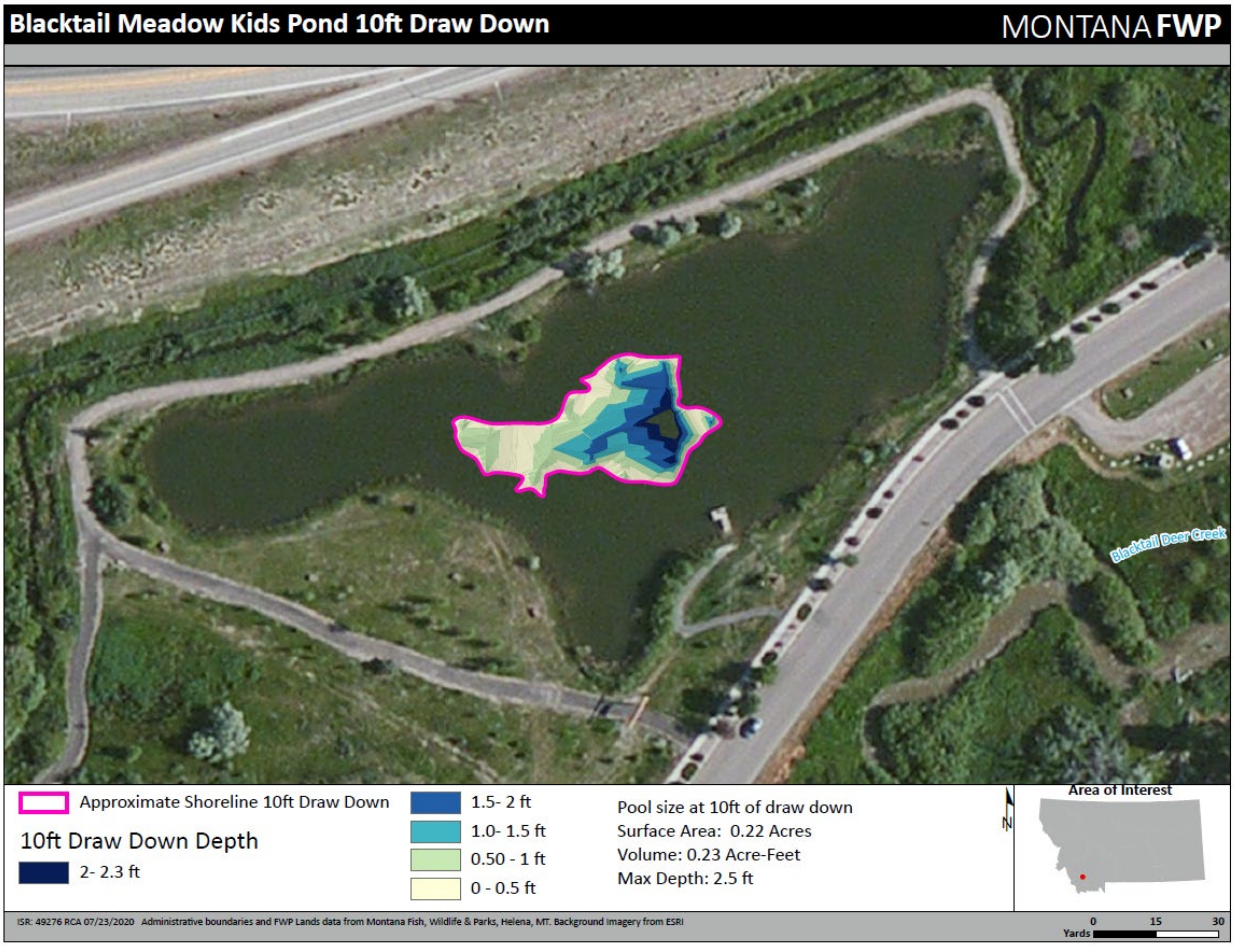

Figure 3. Area of Blacktail Meadows Kid's Pond to be treated following dewatering.

Waters within the project area would be treated with CWE Properties Ltd. CFT Legumine Fish Toxicant. FWP would follow the label recommendations, which is typically within the range of 1.0 and 2.0 ppm, however, to effectively remove Common Carp and other more rotenone tolerant fish species it is recommended to use a stronger treatment of between 2 and 4 ppm. The exact concentration of the selected formulation will be determined in the field by calculating the volume of the pool with the intent of determining the lowest dose that will meet the project objective of eradication of fish in the project area.

The treated volume of Blacktail Meadow Kids Pond will be about 0.23 acre-feet (Figure 3). Approximately 0.15 gallons (0.58 L) of CFT Legumine is required to achieve 2.0 ppm. The amount of rotenone would be doubled if 4 ppm is required to achieve removal of all non-native fish. CFT Legumine would persist in the pond for 1 to 4 weeks depending on water temperature, sunlight, alkalinity, and the amount of groundwater entering the pond from contributing tributaries.

However, FWP expects the rotenone to be diluted to < 2 ppb once the pond refills. If this does not occur, the pond will be manually deactivated with $KMnO_4$ after 7 days.

Access to the treatment area will be closed during the application of rotenone for no longer than 7 days. Signs will be placed at public access points, trail and road crossings, and other avenues where access to the treatment area can be readily obtained.

2.6.4 Method of Application

The rotenone would be applied to the dewatered pool using backpack sprayers. Materials and equipment would be transported to the site by a truck. Treatment would last for approximately 4 hours.

2.6.5 Deactivation

Without detoxification, CFT Legumine would persist in the pond for 1 to 4 weeks depending on water temperature, sunlight, alkalinity, and the amount of groundwater entering the pond from contributing tributaries. However, FWP expects the rotenone to be diluted to < 2 ppb once the pond refills. If this does not occur, the pond will be manually deactivated with $KMnO_4$ within 7 days. If required, FWP will deactivate the rotenone with potassium permanganate ($KMnO_4$) applied using backpack sprayers.

2.6.6 Fate of Dead Fish

Dead fish that surface will be collected and removed from the site to reduce the risk of them becoming an attractant to animals. This will also help reduce the smell and sight of dead fish to the public that that frequently use the area. The collected dead fish will be transported to and disposed of at the Beaverhead County landfill. Dead fish that do not surface will provide nutrients to the pond.

2.6.9 Duration of project

The project will occur over a two-week period in October 2020, with treatment occurring during a four-hour period of one day. If all the fish are not removed during the first treatment, it may be necessary to implement a second treatment to achieve the desired objectives. If a second treatment is required, it will be conducted within 1 year of the initial treatment. The metrics FWP would use to determine success include visual observations of the effectiveness of the first fish kill and may later include the use of gill netting or trap net sampling. Pending monitoring results, the pond will be restocked annually with catchable trout prior to the Kids Fishing Derby.

2.6.10 Monitoring

Gill netting will occur in Spring 2021 prior to fish being stocked. Subsequent monitoring will be conducted annually on Father's Day at the Beaverhead Outdoors Association's Kids Fishing Derby by implementing an angler creel survey.

3 Environmental Review

3.1 *Physical Environment*

3.1.1 Land Resources

LAND RESOURCES **Will the proposed action result in:**	**IMPACT Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Soil instability or changes in geologic substructure?		X				
b. Disruption, displacement, erosion, compaction, moisture loss, or over-covering of soil which would reduce productivity or fertility?		X				
c. Destruction, covering or modification of any unique geologic or physical features?		X				
d. Changes in siltation, deposition or erosion patterns that may modify the channel of a river or stream or the bed or shore of a lake?		X				
e. Exposure of people or property to earthquakes, landslides, ground failure, or other natural hazard?		X				

3.1.2 Water

WATER **Will the proposed action result in:**	**IMPACT Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Discharge into surface water or any alteration of surface water quality including but not limited to temperature, dissolved oxygen or turbidity?			X		YES	2a
b. Changes in drainage patterns or the rate and amount of surface runoff?		X				
c. Alteration of the course or magnitude of flood water or other flows?		X				
d. Changes in the amount of surface water in any water body or creation of a new water body?		X				
e. Exposure of people or property to water related hazards such as flooding?		X				
f. Changes in the quality of groundwater?		X				2f
g. Changes in the quantity of groundwater?		X				
h. Increase in risk of contamination of surface or groundwater?			X		YES	see 2af

i. Effects on any existing water right or reservation?		X				
j. Effects on other water users as a result of any alteration in surface or groundwater quality?		X				See 2j
k. Effects on other users as a result of any alteration in surface or groundwater quantity?		X				
l. Will the project affect a designated floodplain?		X				
m. Will the project result in any discharge that will affect federal or state water quality regulations? (Also see 2a)			X		YES	2m

Comment 2a

The proposed project is designed to intentionally introduce a pesticide to surface water to remove unwanted fish. The impacts would be short term and minor. CFT Legumine 5% liquid rotenone are EPA registered pesticides and are safe to use for removal of unwanted fish when handled properly. The concentration of CFT Legumine 5% liquid proposed is 2.0 ppm in water. FWP expects the pond to detoxify within 2 weeks after rotenone application. Because this pond has no inlet or outlet and is in a closed basin, deactivation is not required and the rotenone will be deactivated naturally within 1 to 4 weeks as the pond refills itself by the process of dilution and the natural breakdown. If the pond is unlikely to be refilled by groundwater before it is ice covered, it will be deactivated with potassium permanganate ($KMnO_4$) applied using backpack sprayers.

Several factors influence rotenone's persistence and toxicity. Warmer water temperatures promote deactivation. Rotenone has a half-life of 14 hours at 24 °C, and 84 hours at 0 °C (Gilderhus et al. 1986, 1988), meaning that half of the rotenone is deactivated and is no longer toxic in that time. As temperature and sunlight increase, so does deactivation of rotenone. Higher alkalinity (>170 mg/L) and pH (>9.0) also increase the rate of deactivation. Rotenone tends to bind to, and react with, organic molecules, and availability of organic matter substantially decreases the persistence of rotenone (Dawson et al. 1991). Dilution from groundwater inputs or tributary streams also contributes to deactivation of rotenone

Dead fish would result from this project, although due to sinking and rapid decomposition a relatively small proportion of dead fish would be noticeable. In Washington lakes, approximately 70 % of rotenone-killed fish did not surface (Bradbury 1986). Although no trout were involved with his study, Parker (1970) reported that at water temperatures of 40 °F and less, dead fish required 20-41 days to surface. The most important factors inhibiting fish from surfacing are cooler water (<50 °F) and deep water (>15 feet). Because the pond will be drained down the remaining water depths will be much less than 15 feet. Most dead fish are expected to surface and will be removed and taken to the landfill.

Decomposition of rotenone-killed fish in lakes can result in temporary nutrient enrichment and algal blooms. In Washington, 9 of 11 treated with rotenone experienced an algal bloom shortly after treatment, and an estimated 70 % of the phosphorus of the fish stock would remain in the

lake with decomposition of fish (Bradbury 1986). Nutrient loading from fish left to decay may temporarily contribute to aesthetically unappealing algal blooms; however, keeping the nutrients within the body of water is beneficial. Fish left in a treated lake contribute towards food web recovery as the nutrients contributed from their decomposing bodies stimulates phytoplankton production which in turn feed zooplankton that recolonize treated lakes. Natural recolonization of zooplankton and other aquatic invertebrates result in reestablishment of the forage base for fish. Any changes or impacts to water quality resulting from decaying fish would be short term and minor.

Comment 2f

No contamination of groundwater is anticipated to result from this project. Because ground water leaving Blacktail Meadow Kids Pond must travel through bed sediments, soil, and gravel, and rotenone is known to bind readily with these substances, FWP does not anticipate any contamination of ground water (Skaar 2001; Engstrom-Heg 1971, 1976; Ware 2002). Rotenone moves only one inch in most soil types; the only exception would be sandy soils where movement is about three inches (Hisata 2002). In California, studies where wells were placed in aquifers adjacent to and downstream of rotenone applications have never detected rotenone, rotenolone, or any of the other organic compounds in the formulated products (CDFG 1994).

Case studies in Montana have concluded that rotenone movement through groundwater does not occur (FWP unpublished data). For example, at Tetrault Lake, Montana, neither rotenone nor inert ingredients were detected in a nearby domestic well which was sampled two and four weeks after applying 1.8 ppm rotenone to the lake. This well was chosen because it was down gradient from the lake and drew water from the same aquifer that fed and drained the lake. FWP has sampled wells and groundwater in several piscicide projects that removed fish from ponds, and no rotenone, or the inert ingredients of the selected formulation, were detected in ponds ranging from 65 to 200 feet from the treated waters. Likewise, application of piscicide to streams has not resulted in contamination of neighboring wells or groundwater. In 2015 and 2016, Soda Butte Creek flowing through Cooke City and Silver Gate, Montana, was treated with CFT Legumine. Wells drawing water from the same open aquifer as the treated stream were sampled during and after the treatment and all found to be free of rotenone.

Comment 2j

The CFT Legumine label states… “Do not use water treated with rotenone to irrigate crops or release within ½ mile upstream of an irrigation water intake in a standing body of water such as a lake, pond, or reservoir. For applications > 40 ppb or 0.04 ppm active rotenone (> 0. 8 ppm 5 % rotenone formulation) in waters with drinking water intakes or hydrologic connections to wells, 7 to 14 days before application, the certified applicator or designee under his/her direct supervision must notify to the party responsible for the public water supply, or individual private water users, to avoid consumption of treated water until: (1) active rotenone is < 0. 04 ppm as determined by analytical chemistry, (2) fish of the *Salmonidae* or *Centrarchidae* families can survive for 24 hours, (3) dilution with untreated water yields a calculation that active rotenone is < 0. 04 ppm, or (4) distance or travel time from the application sites demonstrates that active rotenone is < 0. 04 ppm.

Impacts to irrigation and potable water intakes would be short term and minor. This pond is not used for irrigation purposes, and it is not being used as a potable water intake. The pond and surrounding recreation area will be closed during the treatment to limit human and animal exposure.

Comment 2m

The 2016 Pesticide General Permit issued on a five-year cycle by Montana DEQ provides the authority for FWP to apply piscicides. FWP, and any other piscicide applicator, must develop a pesticide discharge management plan as a condition for coverage under this permit. For FWP, the plan consists of procedures and protocols developed by and detailed in FWP's Piscicide Policy, the AFS Rotenone Standard Operating Procedures manual, and annual training and critique of projects provided by the FWP Piscicide Committee.

3.1.3 Air

AIR **Will the proposed action result in:**	**IMPACT Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Emission of air pollutants or deterioration of ambient air quality? (also see 13 (c))			X			3a
b. Creation of objectionable odors?			X		yes	3b
c. Alteration of air movement, moisture, or temperature patterns or any change in climate, either locally or regionally?		X				
d. Adverse effects on vegetation, including crops, due to increased emissions of pollutants?		X				
e. Will the project result in any discharge which will conflict with federal or state air quality regulations?		X				

Comment 3a

Vehicles, pumps, and small generators used during the treatment create emissions; however, these emissions would dissipate rapidly. Any impacts from these odors would be short term and minor.

Comment 3b

CFT Legumine does not contain the same level of aromatic petroleum solvents (toluene, xylene, benzene and naphthalene) of other rotenone formulations and as a consequence does not have the same odor concerns.

Dead fish would result from this project and may cause objectionable odors (See Section 2a). FWP would expect odors from dead fish to be short term and minor as visible dead fish will be removed and taken to the landfill and most dead fish decay within a few days.

3.1.4 Vegetation

VEGETATION **Will the proposed action result in:**	**IMPACT Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Changes in the diversity, productivity or abundance of plant species (including trees, shrubs, grass, crops, and aquatic plants)?			X			4a
b. Alteration of a plant community?		X				
c. Adverse effects on any unique, rare, threatened, or endangered species?		X				4c
d. Reduction in acreage or productivity of any agricultural land?		X				
e. Establishment or spread of noxious weeds?		X				
f. Will the project affect wetlands, or prime and unique farmland?		X				

Comment 4a

Rotenone does not affect plants at concentrations used to kill fish. Impacts from trampling vegetation at staging or detoxification areas are expected to be short term and minor. This recreation area is maintained regularly and a large area around the pond is mowed and trimmed and maintained for noxious weeds.

Comment 4c.

Rotenone has no impacts on plant species at fish killing concentrations. The only anticipated impacts to sensitive plant species would be a result of trampling by the personnel applying the rotenone to the pond. Any impacts from trampling are expected to be short term and minor. The treatment area is located in a manicured urban setting that does not have sensitive plant species. Any trampling impacts should be fully healed by the following growing season. Impacts to plants can be minimized by staying on existing road and trail systems as much as possible.

3.1.5 Fish/Wildlife

FISH/WILDLIFE **Will the proposed action result in:**	**IMPACT Unknown**	**None**	**Minor**	**Potentially Significant**	**Can Impact Be Mitigated**	**Comment Index**
a. Deterioration of critical fish or wildlife habitat?		X				
b. Changes in the diversity or abundance of game animals or bird species?			X		yes	5b
c. Changes in the diversity or abundance of nongame species?			X		yes	5c
d. Introduction of new species into an area?			X			5d
e. Creation of a barrier to the migration or movement of animals?		X				
f. Adverse effects on any unique, rare, threatened, or endangered species?			X			5f
g. Increase in conditions that stress wildlife populations or limit abundance (including harassment, legal or illegal harvest or other human activity)?		X				5g
h. Will the project be performed in any area in which T&E species are present, and will the project affect any T&E species or their habitat? (Also see 5f)		X				
i. Will the project introduce or export any species not presently or historically occurring in the receiving location? (Also see 5d)			X			5i

Comment 5b

This project is designed to kill undesirable nongame fish. The impact of fish removal will be short term and minor because the pond will be stocked with hatchery trout following treatment.

Comment 5c

Rotenone is highly toxic to fish, and the objective of this project is full eradication of nongame fish species (Common Carp, Longnose Suckers, and White Suckers). Blacktail Meadow Kids Pond will then be stocked with hatchery trout.

The amphibian and reptile community that inhabits the pond is small, and frogs and turtles are rarely seen in the area. From time to time, garter snakes are seen in the vegetation around the perimeter of the pond. Zooplankton and aquatic invertebrates will most likely be negatively affected by the rotenone treatment; however, recolonization by aquatic insects will occur over the year following completion of the treatment.

Fish

Rotenone is highly toxic to fish, and an objective of this project is full eradication/suppression of nongame fish species such as Common Carp, Longnose Sucker, and White Sucker. The pond will be fishless for the 2020-21 winter and will be restocked with trout in Spring 2021. The project will be beneficial to the Dillon community's youth (12 and under) by improving angling opportunity within the pond.

Mammals

Ingestion of rotenone, either from drinking rotenone-treated water or from consuming dead fish or invertebrates from rotenone-treated streams, are the likely routes of exposure for mammals. A substantial body of research has investigated the effects of ingested rotenone in terms of acute and chronic toxicity and other potential health effects. In general, mammals are not affected by rotenone at concentrations used to kill fish. Consuming treated water or rotenone killed fish does not affect mammals at fish killing concentrations because rotenone is neutralized by enzymatic action in their stomach and intestines (AFS 2002). Investigations examining the potential for acute toxicity from ingesting rotenone find that mammals would need to consume impossibly high amounts of rotenone-treated water or rotenone-killed fish to obtain a lethal dose. For example, a 22-pound dog would have to drink nearly 8,000 gallons of treated water within 24 hours or eat 660,000 pounds of rotenone-killed fish within a day to receive a lethal dose (CDFG 1994). A half-pound mammal would need to consume 12.5 mg of pure rotenone or drink 66 gallons of treated water for a lethal dose (Bradbury 1986). The effective concentration of rotenone to kill fish is 0.5 to 1.0 ppm, which is several orders of magnitude lower than concentrations that result in acute toxicity to mammals. Evaluations of mammals' potential exposure to rotenone from scavenging indicate that acute toxicity from ingesting rotenone-killed fish is highly unlikely (EPA 2007).

Chronic toxicity associated with availability of dead fish over time would not pose a threat to mammals, nor would other health effects be likely. Rats and dogs fed high levels of rotenone for 6 months to 2 years experienced only diarrhea, decreased appetite, and weight loss (Marking 1988). The unusually high treatment concentrations did not cause tumors or reproductive problems. Toxicology studies investigating potential secondary effects of rotenone exposure have found no evidence that it results in birth defects (HRI 1982), gene mutations (BRL 1982; Van Geothem et al. 1981), or cancer (Marking 1988). Rats fed diets laced with 10 to 1000 ppm of rotenone over a 10-day period did not experience any reproductive dysfunction (Spencer and Sing 1982). Therefore, chronic exposure to rotenone poses no threat to mammals consuming dead fish or treated water. Rotenone does not persist in the environment which also limits the chronic exposure to mammals or other terrestrial organisms. In X creek, rotenone is only expected to persist for 48 hours, so chronic exposure is unlikely. In X lake rotenone is expected to persist 3-5 weeks thus limiting the potential for chronic exposure.to mammals.

A temporary reduction in prey of aquatic origin has the potential to influence some mammals. The American mink is a piscivorous mammalian that is most likely to occur in the project area. Mink are opportunistic predators and scavengers, with fish and invertebrates comprising a portion of their diet. Therefore, the reduction in density of fish following treatment may displace mink to adjacent, untreated reaches until fish populations recover. Nonetheless, as opportunists, American mink have flexibility to switch to other prey species and have the ability to disperse.

Other mammalian predators may experience short-term and minor consequences. Opportunistic black bears (*Ursus americanus*), raccoons (*Procyon lotor*), red foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), otters (*Lontra canadensis*), and striped skunks (*Mephitis mephitis*) would likely consume dead fish immediately after piscicide treatment. The temporary reductions of aquatic prey, and the brief availability of dead fish, constitute short-term and minor effects on mammalian predators and scavengers.

Birds

Birds have the potential to be exposed to rotenone through ingestion of treated water or scavenging dead fish and invertebrates. Like with mammals, rotenone breaks down rapidly within the gut of birds. Moreover, the concentrations of rotenone in waters treated for fisheries management are far below levels found to be toxic to birds. For example, ¼-pound bird would have to consume 100 quarts of treated water, or more than 40 pounds of fish and invertebrates, within 24 hours, for a lethal dose (Finlayson et al. 2000). The EPA concluded that exposure to rotenone, when applied according to label instructions, presented no unacceptable risks to wildlife (EPA 2007). In summary, this project would have no adverse effect birds that ingest water, dead fish, or dead invertebrates.

Numerous bird species rely on prey of aquatic origin, and a rotenone project has potential to temporarily decrease forage availability. Timing the project for when neotropical migrant songbirds are migrating south mitigates for loss of forage base. Like mammals, birds are highly mobile, so the project may result in short-term displacement of birds that consume fish or aquatic invertebrates.

Reptiles

Reptiles, especially garter snakes, have potential to be exposed to rotenone treated water and could scavenge dead fish. The low concentration of rotenone in water and dead fish indicates reptiles would not experience toxic exposure to rotenone. Moreover, the reptilian gut is likely as efficient, or more efficient, at breaking down rotenone given the ability of reptiles to digest bone, hair, and exoskeletons, all of which are far less degradable than the rotenone molecule.

Amphibians

Amphibians are closely associated with water and have potential to be exposed to rotenone during treatment. In general, adult, air-breathing amphibians are not affected by rotenone at fish killing concentrations (Chandler and Marking 1982, Grisak et al. (2007) but the larvae would likely be affected (Grisak et al 2007, Billman et al 2011). Billman et al. (2011) conducted laboratory toxicity tests of the impacts of rotenone on Columbia spotted frogs and Boreal toads. They found significant mortality to the larval stages of both species if they are exposed for 96 hours to 1 ppm CFT Legumine, but the mortality was less when exposed to lower dosages (0.5 ppm) or for a shorter duration (4 hours or less). In Yellowstone Park rotenone caused nearly 100% mortality in gill-breathing, amphibian tadpoles within 24 hours, but did not affect non-gill breathing metamorphs, juveniles, or adults. In the year(s) following, tadpole repopulation occurred at all water bodies treated with CFT Legumine and population levels were similar to or higher than, pre-treatment levels (Billman et al. 2012). Olsen (2017) found that a concentration of 1 ppm rotenone in the West Fork of Mudd Creek produced 100% mortality of tailed frog tadpoles, but concentrations of 0.75, 0.5 and 0.25 mortality averaged only 33%. To mitigate for

the potential impacts to larval stages of amphibians, the application will occur in the fall (October) when they are not present and adults are dormant.

Zooplankton

Rotenone has greater initial effects on abundance and diversity of zooplankton than lotic invertebrates, given the longer period of exposure (Vinson et al. 2010). Biomass of zooplankton recovers rapidly; however, zooplankton community composition can take from 1 week to 3 years to return to pretreatment conditions (Beal and Anderson 1993: Vinson et al. 2010). Like stream-dwelling invertebrates, zooplankton have life history strategies that aid in rapid recolonization following disturbance (Havel and Shurin 2004). Recovery of zooplankton varies among taxa, with a dramatic bloom of early colonizers in the first couple of months (Anderson and Beal 1993). Other taxa take longer to recover, but the diversity and abundance can return as quickly as 6 months. Post-treatment monitoring in Devine Lake in the Bob Marshall Wilderness found invertebrates increased in number and very slightly increased in diversity following a rotenone treatment (Rumsey et al. 1996). Schnee (2007b) chronicled two years of post-rotenone treatment monitoring for upper and lower Martin lakes near Olney, Montana that were treated with rotenone in 2005. He concluded that zooplankton density two years after the treatment were similar to pre-treatment densities, and in some cases higher. In a Norwegian lake, the zooplankton were sampled before application of CFT Legumine in 2014, immediately after treatment, and 1-year post-treatment in 2015 (Amekleiv et al. 2015). CFT Legumine had an initial negative effect on zooplankton, with none being detected immediately after treatment. The relative abundance of species of zooplankton changed from pretreatment to 1-year post-treatment with some species comprising a much higher proportion of the zooplankton community. In addition, overall abundance of zooplankton increased considerably post treatment. Removal of common roach (*Rutilus rutilus*), a species of minnow that preys on zooplankton, was attributed to greater post-treatment plankton biomass. Many taxa of zooplankton are capable of asexual reproduction, which favors rapid recolonization from existing eggs and zooplankters that survived treatment. Moreover, lakes have a long-term bank of dormant eggs that are resilient to a range of harsh conditions and provide many years of recruitment of zooplankton within a lake. In addition, wind, animals, and humans are primary agents of dispersal of dormant eggs. Based on these studies and characteristics of zooplankton communities, we would expect the plankton species composition in Blacktail Meadow Kids pond to return to pre-treatment diversity and abundance within two years and the impacts of treatment with rotenone to be short term and minor. Leaving dead fish within the pond likely provides the nutrients for recovery of lentic invertebrates, and 70 % of dead fish do not surface (Bradbury 1986).

Stream-Dwelling Aquatic Invertebrates

Investigations into the effects of rotenone on benthic organisms indicate that rotenone can result in temporary reduction of gilled aquatic invertebrates in a stream. Invertebrates that were most sensitive to rotenone also tended to have the highest rate of recolonization due to short life cycles (Engstrom-Heg et al. 1978). Although gill-respiring invertebrates are a sensitive group, many are far less sensitive to rotenone than fish (Schnick 1974; Chandler and Marking 1982; Finlayson et al. 2010). Due to their short life cycles (Anderson and Wallace 1984), strong dispersal ability (Pennack 1989), and generally high reproductive potential (Anderson and Wallace 1984), aquatic invertebrates are capable of rapid recovery from disturbance (Boulton et al. 1992; Matthaei et al.

1996). Following a piscicide treatment of a California stream, macroinvertebrates experienced a resurgence in numbers, with black fly larvae recovering first, followed by mayflies and caddisflies within six weeks after treatment (Cook and Moore 1969). Stoneflies returned to pretreatment abundances by the following spring. Studies suggesting long-term reductions in biomass and presumed absence of species following piscicide treatment examined treatments with markedly higher concentrations and durations of piscicide exposure, with a subsequent treatment occurring within a month of the first treatment (Mangum and Madrigal 1998).

A study of response of benthic invertebrates in streams in Montana and New Mexico used a concentration and duration of CFT Legumine similar to the one that is proposed in this project (Skorupski 2011). In Cherry Creek and Specimen Creek, both in Montana, rotenone resulted in minimal effects on macroinvertebrates immediately after. Rotenone had a greater effect on benthos in streams in New Mexico. Regardless of the initial response, invertebrate communities recovered in all streams within a year. In Norway CFT Legumine was applied at of 0.5 ppm, which is lower than the 1 ppm typical of most piscicide projects in Montana and despite initial reductions in invertebrate abundance, most taxa had recolonized with a year (KJærstad et al. 2014).

Because piscicide has potential to alter abundance and species composition of aquatic invertebrates over the short-term, FWP's Piscicide Policy requires pre- and post-treatment sampling of benthic, aquatic invertebrates (FWP 2012).

The possibility of eliminating a rare or endangered species of aquatic invertebrate in the proposed pond by treating with rotenone is very unlikely. During the initial information gathering phase for this document, the Montana Natural Heritage Program (MNHP) was consulted to determine if there were non-target aquatic species of concern (SOC) present in the treatment area (http://mtnhp. org/SpeciesOfConcern/?AorP=a). There were no invertebrate Species of Concern observed in Blacktail Meadow Kids pond.

Based on the information collected from Blacktail Meadow Kids pond and the studies reviewed above, FWP would expect the aquatic invertebrate species composition and abundance in the streams/lakes proposed for treatment with rotenone to return to pre-treatment diversity and abundance within one to two years after treatment. Therefore, the impacts to aquatic invertebrate communities should be short-term and minor.

Comment 5d

Blacktail Meadow Kids pond will continue to be managed as a kid's fishing pond. Hatchery Rainbow Trout and Westslope Cutthroat will be stocked twice annually to provide a good angling opportunity for youth 12 years and under.

Comment 5f

The chances of any threatened or endangered species being negatively affected by this rotenone treatment is minimal because these species and not in or near the project area. It is possible that osprey or eagles could consume rotenone-killed fish. However, because all the dead fish will be collected and taken to the local landfill this is unlikely. As stated in section 3.1.5 Fish/Wildlife it would take an enormous amount of consumed dead fish to negatively affect wild birds. For

example, ¼-pound bird would have to consume 100 quarts of treated water, or more than 40 pounds of fish and invertebrates, within 24 hours, for a lethal dose (Finlayson et al. 2000).

Comment 5g

There will be an increased number of people (5-10) within the immediate area of the pond during and for the week leading up to treatment. However, because that level of human activity is common within this area there will be no affect or stress to any wildlife species.

Comment 5i

No species will be exported, and stocking of fish will be consistent with historic management of the fishery. Blacktail Meadow Kids Pond is managed as an urban fishery, and it is typically stocked with 200 retired Rainbow Trout brood twice annually (400 total). Stocking usually takes place in May or June of each year. In the past, the pond has been stocked by Ennis National Fish Hatchery, Jocko River Trout Hatchery, and Washoe Park Trout Hatchery. Annually for the next 6 years catchable size Westslope Cutthroat Trout will be stocked in the pond by Washoe Park Trout Hatchery based out of Anaconda, MT.

3.2 *Human Environment*

3.2.1 Noise/Electrical Effects

6. NOISE/ELECTRICAL EFFECTS Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Increases in existing noise levels?			X			6a
b. Exposure of people to serve or nuisance noise levels?		X				
c. Creation of electrostatic or electromagnetic effects that could be detrimental to human health or property?		X				
d. Interference with radio or television reception and operation?		X				

Comment 6a

The only noise generated from this project would be from vehicles, pumps, or small generators. Noise generated from this project is consistent with present levels (pond is in an urban setting adjacent to a paved road). The noise generated from this would be short term and minor.

3.2.2 Land Use

7. LAND USE Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Alteration of or interference with the productivity or profitability of the existing land use of an area?		X				
b. Conflicted with a designated natural area or area of unusual scientific or educational importance?		X				

c. Conflict with any existing land use whose presence would constrain or potentially prohibit the proposed action?			X			7c
d. Adverse effects on or relocation of residences?		X				

Comment 7c

The CFT Label states: "Do not allow recreational access (e.g., wading, swimming, boating, and fishing) within the treatment area while rotenone is being applied." Therefore, during the application of rotenone, the area being treated must be closed to public access. The pond will be closed for no longer than 7 days given the concentrations we will use (2.0 to 4.0 ppm). Any social impacts to individuals who use this area would be short term and minor. Treatment will be scheduled for October when use is low to minimize impacts to users.

3.2.3 Risks/Health Hazards

8. RISK/HEALTH HAZARDS Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Risk of an explosion or release of hazardous substances (including, but not limited to oil, pesticides, chemicals, or radiation) in the event of an accident or other forms of disruption?			X		YES	8a
b. Affect an existing emergency response or emergency evacuation plan or create a need for a new plan?			X		YES	8b
c. Creation of any human health hazard or potential hazard?			X		YES	see 8ac
d. Will any chemical toxicants be used?			X		YES	see 8a

Comment 8a

The principal risk of human exposure to hazardous materials from this project would be limited to the applicators. All applicators would wear safety equipment required by the product label and SDS sheets. All applicators would be trained on the safe handling and application of the piscicide and potassium permanganate. Piscicide applicators become certified applicators upon passing examinations given by the Montana Department of Agriculture. Beyond this, FWP imposes additional requirements on its own employees through its internal piscicide policy (FWP 2012). An independent certified applicator must accompany each treatment, with "independent" status assigned to an individual who would not be expected to work on the treatment as part of their normal duties. Therefore, at least 2 Montana Department of Agriculture certified pesticide applicators would supervise and administer the project. Materials would be transported, handled, applied and stored according to the label specifications to reduce the probability of human exposure or spill.

Comment 8b

FWP requires a treatment plan for rotenone projects. This plan addresses many aspects of safety for people who are on the implementation team such as establishing a clear chain of command, training, delegation and assignment of responsibility, clear lines of communication between members, spill contingency plan, first aid, emergency responder information, personal protective equipment, monitoring and quality control, among others. Implementing this project should not have any impact on existing emergency plans. Because an implementation plan has been developed by FWP, the risk of emergency response is minimal and any effects to existing emergency responders would be short term and minor.

Comment 8c

Information examined here includes an analysis of human health risks relating to rotenone exposure (EPA 2007, Fisher 2007). Acute toxicity refers to the adverse effects of a substance from either a single exposure or multiple exposures in a short space of time. Rotenone ranks as having high acute toxicity through oral and inhalation routes of exposure, and low acute toxicity through exposure to skin (EPA 2007). Acute toxicity would be applicable to undiluted rotenone formulation, with median lethal doses for rats ranging from 39. 5 mg/kg for female rats, and 102 mg/kg for male rats. A rat would need to ingest or inhale 0.04 g of undiluted rotenone for a lethal dose. As rotenone is 5% of most rotenone formulations, a 1 kg rat would have to consume 0.63mL of formulation to receive a lethal dose. Because the treatment area would be closed to public access during rotenone application, exposer of humans to undiluted 5% rotenone formulation would not occur. Only personnel involved in the project who actively measure and applying the chemical could be exposed. Oral or inhalation risks for these persons can be reduced or eliminated by proper use of personal protective equipment.

Chronic exposure is repeated oral, dermal, or inhalation of the target chemical (EPA 2007). In humans, chronic exposure is the length of time equivalent to approximately 10% of the life span. In piscicide treatments in streams, exposure to rotenone lasts at most 4 days. Therefore, the only people likely to experience chronic exposure are the applicators who dispense diluted CFT Legumine over multiple projects. The use of protective eyewear, gloves and dust/mist respirators (in the case of handheld devices that dispense rotenone) are sufficient to protect worker health.

The analysis of dietary risks considered threats to the subgroup “females 13-49 years old” and examined exposure associated with consuming exposed fish and drinking treated surface water (EPA 2007). In determining potential exposure from consuming fish, the EPA used maximum residues in fish tissue. The concentrations of residue considered were conservative, meaning that they may have been an overestimate of the rotenone concentrations in muscle tissue, as they included unpalatable tissues where concentrations may be higher. The EPA concluded that acute dietary exposure estimates resulted in a dietary risk below the EPA’s level of concern; therefore, consumption of fish killed by rotenone does not present an acute risk to the sensitive subgroup.

Table 2: Toxicological endpoints for rotenone (EPA 2007)

Exposure Scenario	**Dose Used in Risk Assessment, Uncertainty Factor (UF)**	**Level of Concern for Risk Assessment**	**Study and Toxicological Effects**
Acute Dietary (females 13-49)	NOAEL = 15 mg/kg/day UF = 1000 aRfD = 15 mg/kg/day = 0. 015 mg/kg/day 1000	Acute PAD = 0. 015 mg/kg/day	Developmental toxicity study in mouse (MRID 00141707, 00145049) LOAEL = 24 mg/kg/day based on increased resorptions
Acute Dietary (all populations)	An appropriate endpoint attributable to a single dose was not identified in the available studies, including the developmental toxicity studies.		
Chronic Dietary (all populations)	NOAEL = 0. 375 mg/kg/day UF = 1000 cRfD = 0. 375 mg/kg/day = 0. 0004 mg/kg/day 1000	Chronic PAD = 0. 0004 mg/kg/day	Chronic/oncogenicity study in rat (MRID 00156739, 41657101) LOAEL = 1. 9 mg/kg/day based on decreased body weight and food consumption in both males and females
Incidental Oral Short-term (1-30 days) Intermediate-term (1-6 months)	NOAEL = 0. 5 mg/kg/day	Residential MOE = 1000	Reproductive toxicity study in rat (MRID 00141408) LOAEL = 2. 4/3. 0 mg/kg/day [M/F] based on decreased parental (male and female) body weight and body weight gain
Dermal Short-, Intermediate-, and Long-Term	NOAEL = 0. 5 mg/kg/day 10% dermal absorption factor	Residential MOE = 1000 Worker MOE = 1000	Reproductive toxicity study in rat (MRID 00141408) LOAEL = 2. 4/3. 0 mg/kg/day
Inhalation Short-term (1-30 days) Intermediate-term (1-6 months)	NOAEL = 0. 5 mg/kg/day 100% inhalation absorption factor	Residential MOE = 1000 Worker MOE = 1000	[M/F] based on decreased parental (male and female) body weight and body weight gain
Cancer (oral, dermal, inhalation)	Classification; No evidence of carcinogenicity		

UF = uncertainty factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, aPAD = acute population adjusted dose, cPAD = chronic population adjusted does, RfD = reference dose, MOE = margin of exposure, NA = Not Applicable

The EPA analysis of acute dietary risk for both food and drinking water concluded;

When rotenone is used in fish management applications, food exposure may occur when individuals catch and eat fish that either survived the treatment or were added to the water body (restocked) prior to complete degradation. Although exposure from this route is unlikely for the general U.S. population, some people might consume fish following a rotenone application. EPA used maximum residue values from a bioaccumulation study to estimate acute risk from consuming fish from treated water bodies. This estimate is considered conservative because the bioaccumulation study measured total residues in edible portions of fish including certain non-edible portions (skin, scales, and fins) where concentrations may be higher than edible portions (tissue) and the Agency assumed that 100% of fish consumption could come from rotenone exposed fish. In addition, fish are able to detect rotenone's presence in water and, when possible, attempt to avoid the chemical by moving from the treatment area. Thus, for partial kill uses, surviving fish are likely those that have intentionally minimized exposure.
Acute exposure estimates for drinking water considered surface water only because rotenone is only applied directly to surface water and is not expected to reach groundwater. The estimated drinking water concentration (EDWC) used in dietary exposure estimates was 200 ppb, the solubility limit of rotenone. The drinking water risk assessment is conservative because it assumes water is consumed immediately after treatment with no degradation and no water treatment prior to consumption.
Acute dietary exposure estimates result in dietary risk below the Agency's level of concern. Generally, EPA is concerned when risk estimates exceed 100% of the acute population adjusted dose (aPAD). The exposure for the "females 13-49 years old" subgroup (0.1117 mg/kg/day) utilized 74% of the aPAD (0.015 mg/kg/day) at the 95th percentile (see Table 5). It is appropriate to consider the 95th percentile because the analysis is deterministic and unrefined. Measures implemented as a result of this RED will further minimize potential dietary exposure (see Section IV).

As for evaluating the human chronic risk from exposure to rotenone treated water, the EPA acknowledges the four principle reasons for concluding there is a low risk. First, the rapid natural degradation of rotenone. Second, using active detoxification measures by applicators such as potassium permanganate. Next, properly following piscicide labels which prohibit the use near water intakes. Finally, proper signing, public notification or area closures which limit public exposure to rotenone treated water.

No recreational access (e.g., wading, swimming, boating, and fishing) would be allowed within the treatment area while rotenone is being applied. At applications rates less than 1.8 ppm, there is no risk to human health after the chemical has been applied to the water and once the rotenone is mixed recreational access can be restored. At application rates greater than 1.8 ppm in streams, recreational access can be restored 72 hours after application is complete. For lakes and ponds where rotenone is applied at 1.8 ppm or more, recreational access can be restored following a 24-hour bioassay demonstrating survival of sentinel fish or 14 days, whichever is less. The pond and surrounding area may be closed for no more than 7 days given the treatment duration and concentrations we will use (2.0 to 4.0 ppm). The aggregate risk to human health from food, water, and swimming does not exceed the EPA level of concern (EPA 2007).

Recreationists in the area would likely not be exposed to the treatments because a temporary closure would preclude any from being in the area. Proper warning through news releases, signing the project area, road closure, and administrative personnel in the project area should be adequate to keep unintended recreationists from being exposed to any treated waters. Administering application in the late summer would further reduce exposure due to the relatively low number of users in this area.

The occupational risks to humans is low if proper safety equipment and handling procedures are followed as directed by the product labels (EPA 2007). The major risks to human health from rotenone come from accidental exposure during handling and application. This is the only time when humans are exposed to concentrations that are greater than that needed to remove fish. To prevent accidental exposure to liquid formulated or powdered rotenone, the Montana Department of Agriculture requires applicators to be:

- Trained and certified to apply the pesticide in use
- Equipped with the proper safety gear, which, in this case, includes
- respirator, eye protection, rubberized gloves, hazardous material suit
- Have product labels with them during use
- Contain materials only in approved containers that are properly labeled
- Adhere to the product label requirements for storage, handling, and application

Any threats to human health during application would be greatly reduced with proper use of safety equipment. There is an inhalation risk to ground applicators. To guard against this, ground applicators would be equipped with protective clothing, eye, and respirators.

Fisher (2007) conducted an analysis of the inert constituent ingredients found in the rotenone formulation of CFT Legumine for the California Department of Fish and Game. These inert ingredients are principally found in the emulsifying agent Fennodefo^{99} which helps make the generally insoluble rotenone more soluble in water. The constituents were considered because of their known hazard status and not because of their concentrations in the Legumine formulation. Solvents such as xylene, trichloroethylene (TCE), and tetrachloroethylene are residue left over from the process of extracting rotenone from the root and can be found in some lots of Legumine. However, inconsistent detectability and low occurrence in other formulations that used the same extraction process were below the levels for human health and ecological risk. Solvents such as toluene, *n*-butylbenzene, 1,2,4 trimethylbenzene, and naphthalene are present in Legumine, and when used in other applications can be an inhalation risk. However, because of their low concentrations in this formulation, the human health risk is low. The remaining constituents, the fatty acid esters, resin acids, glycols, substituted benzenes, and *1*-hexanol were likewise present but either analyzed, calculated, or estimated to be below the human health risk levels when used in a typical fish eradication project.

Methyl pyrrolidone is also found in CFT Legumine. It is known to have good solvency properties and is used to dissolve a wide range of compounds including resigns (rotenone). Analysis of

Methyl pyrrolidone in CFT Legumine showed it represents about 9% of the formulation (Fisher 2007). The analysis concluded regarding the constituent ingredients in CFT Legumine;

> "…None of the constituents identified are considered persistent in the environment nor will they bioaccumulate. The trace benzenes identified in the solvent mixture of CFT Legumine™ will exhibit limited volatility and will rapidly degrade through photolytic and biological degradation mechanisms. The PEGs are highly soluble, have very low volatility, and are rapidly biodegraded within a matter of days. The fatty acids in the fatty acid ester mixture (Fennodefo99™) do not exhibit significant volatility, are virtually insoluble, and are readily biodegraded, although likely over a slightly longer period of time than the PEGs in the mixture. None of the new compounds identified exhibit persistence or are known to bioaccumulate. Under conditions that would favor groundwater exchange the highly soluble PEGs could feasibly transmit to groundwater, but the concentrations in the reservoir, and the rapid biodegradation of these constituents makes this scenario extremely unlikely. Based upon a review of the physical chemistry of the chemicals identified, we conclude that they are rapidly biodegraded, hydrolyzed and/or otherwise photolytically oxidized and that the chemicals pose no additional risk to human health or ecological receptors from those identified in the earlier analysis. None of the constituents identified appear to be at concentrations that suggest human health risks through water, or ingestion exposure scenarios and no relevant regulatory criteria are exceeded in estimated exposure concentrations…"

To limit exposure to those applying rotenone, proper safety equipment would be used according to the label requirements.

The advantage of CFT Legumine over Prenfish is that it has less petroleum hydrocarbon solvents such as toluene, xylene, benzene and naphthalene. By comparison, Prenfish has a strong chemical odor. CFT Legumine is virtually odor-free and performs almost identically to Prenfish.

Concern over a potential link between rotenone and Parkinson's disease often emerges in piscicide projects. Research into links between rotenone and PD include laboratory studies intended to induce PD-like symptoms in laboratory animals as a tool for neuroscientists to conduct PD-related research (Betarbet et al. 2000; Johnson and Bobvraskaya 2015), epidemiological studies of PD in farm workers (Kamel et al. 2006; Tanner et al. 2011), and laboratory studies evaluating risks associated with inhalation (Rojo et al. 2007). Laboratory studies inducing PD-like symptoms do not provide a relevant model for field exposure by humans. These studies entail injection into the bloodstream of extremely high concentrations of rotenone, often with a chemical carrier to facilitate absorption into tissue, for long durations. Such studies have little applicability to uses of rotenone as a piscicide.

Epidemiological studies do not provide clear evidence that rotenone has a causal link with PD. A recent study linked the use of rotenone and paraquat with the development of Parkinson's disease in humans later in life (Tanner et al. 2011). The after the fact study included mostly farmers from 2 states within the United States who presumably used rotenone for terrestrial application to crops and/or livestock. The results of epidemiological studies of pesticide exposure, such as this one, have been highly variable (Guenther et al. 2011). Studies have found no correlations between pesticide exposure and PD (e.g., Jiménez-Jiménez 1992; Hertzman

1994; Engel et al. 2001; Firestone et al. 2010), some have found correlations between pesticide exposure and PD (e.g., Hubble et al. 1993; Lai et al. 2002; Tanner et al. 2011), and some have found it difficult determine which pesticide or pesticide class is implicated if associations with PD occur (e.g., Engel et al. 2001; Tanner et al. 2009). Recently, epidemiological studies linking pesticide exposure to PD have been criticized due to the high variation among study results, generic categorization of pesticide exposure scenarios, questionnaire subjectivity, and the difficulty in evaluating the causal factors in the complex disease of PD, which may have multiple causal factors (age, genetics, environment) (Raffaele et al. 2011). A specific concern is the inability to assess the degree of exposure to certain chemicals including rotenone, particularly the concentration of the chemical, frequency of use, application (e.g., agricultural, insect removal from pets), and exposure routes (Raffaele et al. 2011). No information is given in the Tanner et al. (2011) study about the formulation of rotenone used (powder or liquid) or the frequency or dose farmers were exposed to during their careers. There is also no information given about the personal protective equipment used or any information about other pesticides farmers were exposed to during the period of the study. Without information on how much rotenone individuals were exposed to and for how long, it is difficult to evaluate the potential risk to humans of developing Parkinson's disease from aquatic applications of rotenone products. Laboratory studies of risks associated with inhalation of rotenone of concentrations likely encountered by fieldworkers have not found PD-like symptoms in exposed rodents (Rojo et al. 2007).

The State of Arizona conducted an exhaustive review to the risks to human health of rotenone use as a piscicide (Guenther et al. 2011). They concluded:

> "To date, there are no published studies that conclusively link exposure to rotenone and the development of clinically diagnosed PD. Some correlation studies have found a higher incidence of PD with exposure to pesticides among other factors, and some have not. It is very important to note that in case-control correlation studies, causal relationships cannot be assumed and some associations identified in odds-ratio analyses may be chance associations. Only one study (Tanner et al. 2011) found an association between rotenone and paraquat use and PD in agricultural workers, primarily farmers. However, there are substantial differences between the methods of application, formulation, and doses of rotenone used in agriculture and residential settings compared with aquatic use as a piscicide, and the agricultural workers interviewed were also exposed to many other pesticides during their careers. Through the EPA reregistration process of rotenone, occupational exposure risk is minimized by: new requirements that state handlers may only apply rotenone at less than the maximum treatment concentrations (200 ppb), the development of engineering controls to some of the rotenone dispensing equipment and requiring handlers to wear specific PPE."

To reduce the potential for exposure of the public to rotenone during the proposed treatment, areas treated with rotenone would be closed to public access. Placard signs would be placed at access points informing the public of the closure and the presence rotenone treated waters. Personnel would be onsite to inform the public and escort them from the treatment area should they enter. Rotenone treated waters would be contained to the proposed treatment area because

there is no inlet or outlet. If the rotenone is not deactivated by dilution to < 2 ppb while the pond is refilling or through other natural break down processes within 7 days after the treatment, potassium permanganate would be used to deactivate any remaining rotenone. The efficacy of the deactivation would be monitored using fish (the most sensitive species to the chemical) and a hand-held chlorine meter. Therefore, the potential for public exposure to rotenone treated waters is very minimal. The potential for exposure would be greatest for those certified applicators and operators applying the chemical. To reduce their exposure, label mandates for personal protective equipment would be adhered to (see Comment 8a).

3.2.4 Community Impact

9. COMMUNITY IMPACT Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Alteration of the location, distribution, density, or growth rate of the human population of an area?		X				
b. Alteration of the social structure of a community?		X				
c. Alteration of the level or distribution of employment or community or personal income?		X				
d. Changes in industrial or commercial activity?		X				
e. Increased traffic hazards or effects on existing transportation facilities or patterns of movement of people and goods?		X				

3.2.5 Public Services/Taxes/Utilities

10. PUBLIC SERVICES/TAXES/UTILITIES Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Will the proposed action have an effect upon or result in a need for new or altered governmental services in any of the following areas: fire or police protection, schools, parks/recreational facilities, roads or other public maintenance, water supply, sewer or septic systems, solid waste disposal, health, or		X				

other governmental services? If any, specify:						
b. Will the proposed action have an effect upon the local or state tax base and revenues?		X				
c. Will the proposed action result in a need for new facilities or substantial alterations of any of the following utilities: electric power, natural gas, other fuel supply or distribution systems, or communications?		X				
d. Will the proposed action result in increased used of any energy source?		X				
e. Define projected revenue sources		X				
f. Define projected maintenance costs		X				

3.2.6 Aesthetics/Recreation

11. AESTHETICS/RECREATION Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Alteration of any scenic vista or creation of an aesthetically offensive site or effect that is open to public view?		X				
b. Alteration of the aesthetic character of a community or neighborhood?		X				
c. Alteration of the quality or quantity of recreational/tourism opportunities and settings? (Attach Tourism Report)			X		yes	See 11c
d. Will any designated or proposed wild or scenic rivers, trails or wilderness areas be impacted? (Also see 11a, 11c)		X				

Comment 11c:

There will be a temporary loss of angling opportunity at Blacktail Meadows Kids Pond between the time of fish removal and repopulation (winter 2020-21). The treatment would occur in late October 2020, and restocking would occur in April 2021. This schedule would result in loss of a

wintertime angling opportunity for six months. After project completion, angling opportunity would resume, the fishery would be improved, and management as an urban Kid's Pond fishery would continue. A tourism report is not necessary to quantify these impacts.

3.2.7 Cultural/Historic Resources

12. CULTURAL/HISTORIC RESOURCES Will the proposed action result in:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Destruction or alteration of any site, structure or object of prehistoric historic, or paleontological importance?		X				
b. Physical change that would affect unique cultural values?		X				
c. Effects on existing religious or sacred uses of a site or area?		X				12c
d. Will the project affect historic or cultural resources?		X				

Comment 12c:

There will be no ground-breaking activities associated with this project, and no known cultural or religious ceremonies proposed for the same time this project is proposed. There will be no impacts to historical, cultural, or religious values.

3.2.8 Summary Evaluation of Significance

13. SUMMARY EVALUATION OF SIGNIFICANCE Will the proposed action, considered as a whole:	IMPACT Unknown	None	Minor	Potentially Significant	Can Impact Be Mitigated	Comment Index
a. Have impacts that are individually limited, but cumulatively considerable? (A project or program may result in impacts on two or more separate resources which create a significant effect when considered together or in total.)		X				
b. Involve potential risks or adverse effects which are uncertain but extremely hazardous if they were to occur?		X				
c. Potentially conflict with the substantive requirements of any local, state, or federal law, regulation, standard or formal plan?		X				

d. Establish a precedent or likelihood that future actions with significant environmental impacts will be proposed?		X				
e. Generate substantial debate or controversy about the nature of the impacts that would be created?	X	X			yes	13e
f. Is the project expected to have organized opposition or generate substantial public controversy? (Also see 13e)	X	X				13f
g. List any federal or state permits required.						13g

Comments 13e and f

The use of pesticides can generate controversy from some people. Public outreach and information programs can educate the public on the use of pesticides. It is not known if this project would have organized opposition. This project has been scoped to the Beaverhead Outdoors Association, who cooperatively maintains the Kid's Pond with FWP and annual hosts a kid's fishing event. They are supportive and are partnering on the project by renting dewatering pumps.

Comment 13g

The following permit would be required:

MDEQ Pesticide General Permit

4 ALTERNATIVES

4.1 *Alternatives Evaluated*

4.1.1 Removing non-game Commom Carp, Longnose Sucker and White Sucker from Blacktail Meadow Kids Pond with rotenone.

This alternative would be highly beneficial to Blacktail Meadow Kids Pond and would be a substantially improve angling opportunities for the youth (12 and under) of Dillon, Montana, and the surrounding community. It has a high probability of success and would have short-term, minor effects on wildlife, recreation, and vegetation. FWP has numerous examples of successful projects with similar objectives.

4.1.2 Alternative 2 – No Action.

The no action alternative would maintain nongame Common Carp, Longnose Sucker, and white Sucker. The Kid's Pond would remain turbid, fish stunted, and angler experience and opportunity limited.

4.1.3 Alternative 3 – Physical removal of non-game fish with Fyke/Trap nets.

Trap Nets have been used to remove unwanted fish from ponds with limited success. Mechanical suppression by continuously setting nets has been used to control certain fish species within some waterbodies; however, it requires continuous effort and its inefficiency of removing small-

bodied fish necessitates implementing this approach in perpetuity. Nongame fish species can be controlled through physical removal, but they cannot be completely eradicated. As such, it does not achieve project goals (removal of nongame fish) and results in a less cost effective, long term commitment.

5 Public Comments Instructions

FWP will sponsor a public meeting to provide information and obtain public comment. A meeting will take place at the Beaverhead Search and Rescue Building on September 3 at 6 pm or via online video platform if necessitated by COVID restrictions. The comment period is 30 days. Comments must be received by 5 p.m. September 30, 2020.

Interested parties should send comments to:

Montana Fish, Wildlife & Parks – Region 3
c/o Blacktail Meadow Kids Pond Nongame Fish Removal
1400 S. 19th Ave. Bozeman, MT 59718
406-577-7900
fwprg3ea@mt.gov

Prepared by: Lucas Bateman and Matthew Jaeger Date: 8/2/2020

6 LITERATURE CITED

AFS (American Fisheries Society). 2002. Rotenone stewardship program, fish management chemicals subcommittee. www. fisheries. org/rotenone/.

Anderson, N. H. and J. B. Wallace. 1984. Habitat, life history, and behavioral adaptations of aquatic insects. Pages 38-58 in R. W. Merritt and K. W. Cummins (eds.), An introduction to the aquatic insects of North America. 2nd ed. Kendall/Hunt Publishing, Dubuque, Iowa.

Atkinson, E. C. and C. R. Peterson. 2000. Amphibians and reptiles of the Gallatin National Forest, Montana. Bozeman, Montana.

Benjamin JR, Fausch KD, Baxter CV. 2011. Species replacement by a nonnative salmonid alters ecosystem function by reducing prey subsidies that support riparian spiders. Oecologia 167: 503–512

Betarbet, R., T. B. Sherer, G. MacKenzie, M. Garcia-Osuna, A. V. Panov, and T. Greenamyre. 2000. Chronic systemic pesticide exposure reproduces features of Parkinson's disease. Nature Neuroscience. 3 (12): 1301-1306.

Billman, H. G., S. St-Hilaire, C. G. Kruse, T. S. Peterson, and C. R. Peterson. 2011. Toxicity of the piscicide rotenone to Columbia spotted frog and boreal toad tadpoles. Transactions of the American Fisheries Society 140:919-927.

Billman, H. G., C. G. Kruse, S. St-Hilaire, T. M. Koel, J. L. Arnold, and C. R. Peterson. 2012. Effects of rotenone on Columbia spotted frogs Rana luteiventris during field applications in lentic habitats in southwestern Montana. North American Journal of Fisheries Management. 32:781-789.

Boulton, A. J., C. G Peterson, N. B. Grimm, and S. G. Fisher. 1992. Stability of an aquatic macroinvertebrate community in a multiyear hydrologic disturbance regime. Ecology. 73 (6):2192-2207.

Bradbury, A. 1986. Rotenone and trout stocking: a literature review with special reference to Washington Department of Game's lake rehabilitation program. Fisheries management report 86-2. Washington Department of Game.

BRL (Biotech Research Laboratories). 1982. Analytical studies for detection of chromosomal aberrations in fruit flies, rats, mice, and horse bean. Report to U. S. Fish and Wildlife Service (USFWS Study 14-16-0009-80-54). National fishery research Laboratory, La Crosse, Wisconsin.

Burckhardt, J, B. Bradshaw, J. Deormedi, R. Gipson, and M. Smith. 2014. A plan for the management and conservation of Yellowstone cutthroat trout in Wyoming. Wyoming Game and Fish Department, Cheyenne, Wyoming.

CDFG (California Department of Fish and Game), 1994. Rotenone use for fisheries management, July 1994, final programmatic environmental impact report. State of California Department of Fish and Game.

Chandler, J. H. and L. L. Marking. 1982. Toxicity of rotenone to selected aquatic invertebrates and frog larvae. The Progressive Fish Culturist. 44(2):78-80.

Cook, S. F. and R. L. Moore. 1969. The effects of a rotenone treatment on the insect fauna of a California stream. Transactions of the American Fisheries Society 83 (3):539-544.

Cutkomp, L. K. 1943. Toxicity of rotenone to animals: a review and comparison of responses shown by various species of insects, fishes, birds, mammals, etc. Soap and Sanitary Chemicals. 19(10):107-123.

Dawson, V. K., W. H. Gingerich, R. A. Davis, and P. A. Gilderhus. 1991. Rotenone persistence in freshwater ponds: effects of temperature and sediment adsorption. North American Journal of Fisheries Management. 11:226-231.

Dunham J. B., G. L. Vinyard, and B. E. Rieman. 1997. Habitat fragmentation and extinction risk of Lahontan cutthroat trout. North American Journal of Fisheries Management 17: 1126-1133.

Durkin, P. R. 2008. Rotenone Human Health and Ecological Risk Assessment: FINAL REPORT. USDA Forest Service Contract: AG-3187-C-06-0010, USDA Forest Order Number: AG-43ZP-D-07-0010, SERA Internal Task No. 52-11. Syracuse Environmental Research Associates, Inc. Fayetteville, New York. 152 pages + appendices. Available at: http://www. fs. fed. us/forest health/pesticide/pdfs/0521103a_Rotenone. pdf

Endicott, C. E. and 12 other authors. 2013. Yellowstone cutthroat trout conservation strategy for Montana. Montana Fish, Wildlife & Parks. Livingston, Montana.

Endicott, C. E. and 7 other authors. 2012. Yellowstone cutthroat trout for the Shields River watershed above the Chadbourne diversion. Report prepared for the Montana Cutthroat Trout Steering Committee.

Engel LS, Seixas NS, Keifer MC, Longstreth WTJ & Checkoway H. 2001. Validity study of self-reported pesticide exposure among orchardists. J Expo Anal Environ Epidemiol, 11, 359–368

Engstrom-Heg, R, R. T. Colesante, and E. Silco. 1978. Rotenone tolerances of stream-bottom insects. New York Fish and Game Journal. 25 (1):31-41.

Engstrom-Heg, R. 1971. Direct measure of potassium permanganate demand and residual potassium permanganate. New York Fish and Game Journal. 18(2):117-122.

EPA, 2007. United States Environmental Protection Agency, prevention, pesticides and toxic substances (7508P). EPA 738-R-07-005. Reregistration Eligibility Decision for Rotenone, List A Case No. 0255.

Finlayson, B. J., R. A. Schnick, R. L. Cailteux, L. DeMong, W. D. Horton, W. McClay, C. W. Thompson, and G. J. Tichacek. 2000. Rotenone use in fisheries management: administrative and technical guidelines manual. American Fisheries Society, Bethesda, Maryland.

Fisher, J. P. 2007. Screening level risk analysis of previously unidentified rotenone formulation constituents associated with the treatment of Lake Davis. for California Department of Fish and Game. Environ International Corporation, Seattle, Washington.

FWP. 2014. Statewide fisheries management plan. Montana Fish, Wildlife & Parks, Helena, Montana.

FWP. 2012. Piscicide Policy. Montana Fish, Wildlife & Parks, Fisheries Bureau.

Gilderhus, P. A., J. L. Allen, and V. K. Dawson. 1986. Persistence of rotenone in ponds at different temperatures. North American Journal of Fisheries Management. 6: 129-130.

Gilderhus, P. A., V. K. Dawson, and J. L. Allen. 1988. Deposition and persistence of rotenone in shallow ponds during cold and warm seasons. US Fish and Wildlife Service Investigations in Fish Control, No. 5

Gingerich, W. and J. Rach. 1985. Uptake, accumulation and depuration of 14C-rotenone in blue gills (Lepomis macrochirus). Aquatic Toxicology 6:170-196.

Gleason, M., R. Gosselin, H. Hodge, and P. Smith 1969. Clinical toxicology of commercial products. The William and Wilkins Company, Baltimore, Maryland.

Grisak, G. G., D. R. Skaar, G. L. Michael, M. E. Schnee and B. L. Marotz. 2007. Toxicity of Fintrol (antimycin) and Prenfish (rotenone) to three amphibian species. Intermountain Journal of Sciences. 13(1):1-8.

Hertzman C, Wiens M, Snow B, Kelly S & Calne D. 1994. A case–control study of Parkinson's disease in a horticultural region of British Columbia. Mov Disord, 90: 69–75

Hisata, J. S. 2002. Lake and stream rehabilitation: rotenone use and health risks. Final supplemental environmental impact statement. Washington Department of Fish and Wildlife, Olympia. Washington.

Houf, L. J. and R. S. Campbell. 1977. Effects of antimycin a and rotenone on macrobenthos in ponds. Investigations in fish control number 80. U. S. Fish and Wildlife Service. Fish Control Laboratory, LaCrosse, Wisconsin.

HRI (Hazelton Raltech Laboratories). 1982. Teratology studies with rotenone in rats. Report to U. S. Geological Survey. Upper Midwest Environmental Sciences Center (USFWS Study 81-178). La Crosse, Wisconsin.

Hubble JP, Cao T, Hassanein RES, Neuberger JS & Koller WC. 1993 Risk factors for Parkinson's disease. Neurology, 43:1693-1697.

Jiménez-Jiménez FJ, Mateo D & Giménez-Roldán S. 1992. Exposure to well water and pesticides in Parkinson's disease: Acase–control study in the Madrid area. Mov Disord, 7, 149–152.

Johnson, M. E. and L. Bobrovskaya. 2015. An update on the rotenone models of Parkinson's disease: Their ability to reproduce the features of clinical disease and model gene-environment interactions. Neurotoxicity 46:101-116.

Koel, T. M., J. L. Arnold, P. E. Bigelow and M. E. Ruhl. 2010. Native fish conservation plan. *Environmental assessment. National Park Service, U. S. Department of the Interior,* Yellowstone National Park. December 16, 2010. http://parkplanning. nps. gov/projectHome. cfm?projectID=30504

Kruse, C. G., W. A. Hubert, and F. J. Rahel. 2000. Status of Yellowstone cutthroat trout in Wyoming waters. North American Journal of Fisheries Management 20: 693-705.

Lai, BCL, Marion SA, Teschke K & Tsui JKC. 2002. Occupational and environmental risk factors for Parkinson's disease. Parkinsonism Rel Disord, 8:297–309

Leary, R. 2005. Genetics letter to Jim Olsen. University of Montana Conservation Genetics Laboratory, Division of Biological Sciences, University of Montana, Missoula, Montana.

Leary, R. 2014. Genetics letter to Todd Koel. University of Montana Conservation Genetics Laboratory, Division of Biological Sciences, University of Montana, Missoula, Montana.

Lepori F., Benjamin J. R., Fausch K. D. and C. V. Baxter. 2012 Are invasive and native trout functionally equivalent predators? Results and lessons from a field experiment. Aquatic Conservation of Marine Freshwater Ecosystems. 22: 787–798.

Lui, Y, J. D. Sun, L. K Song, J. Li, S. Chu. Y. Yuan, and N. Chen. 2015. Environment-contact administration of rotenone: A new rodent model of Parkinson's disease. Behavioral Brain Research 294:149-161.

Marking, L. L. 1988. Oral toxicity of rotenone to mammals. Investigations in fish control, technical report 94. U. S, Fish and Wildlife Service, National Fisheries Research Center, La Crosse, Wisconsin.

Matthaei, C. D., Uehlinger, U., Meyer, E. I., Frutiger, A. 1996. Recolonization by benthic invertebrates after experimental disturbance in a Swiss prealpine river. Freshwater Biology. 35(2):233-248.

Maxell, B. 2009. Distribution, identification, status, and habitat use of Montana's amphibians and reptiles. Montana Natural Heritage Program. Helena, Montana.

Maxell, B. A., and D. G. Hokit. 1999. Amphibians and Reptiles. Pages 2. 1-2. 29 in G. Joslin and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife, Montana Chapter of The Wildlife Society. 307pp.

Mihuc, T. B. and G. W. Minshall. 1995. Trophic generalists vs. trophic specialists: implications for food web dynamics in post-fire streams. Ecology 76(8):2361-2372

Minshall, G. W. 2003. Responses of stream benthic invertebrates to fire. Forest Ecology and Management. 178:155-161.

Montana Cutthroat Trout Steering Committee (MCTSC). 2007. Memorandum of understanding and conservation agreement for westslope cutthroat trout and Yellowstone cutthroat trout in Montana.

National Academy of Sciences NAS. 1983. Drinking water and health, volume 5. Safe Drinking Water Committee Board of Toxicology and Environmental Health Hazards, Commission on Life Sciences, National Research Council, National Academy Press, Washington D. C.

Olsen, J. R. 2017. Streams Surveyed in the Big Hole Drainage 2010-2016. Federal Aid Project Number: F-113 April 1, 2011 – April 1, 2017. Montana Fish, Wildlife and Parks, Helena, MT.

Pennack, 1989. Freshwater Invertebrates of the United States, John Wouldey & Sons and Company, New York, New York.

Peterson, D. P, B. E. Rieman, J. B. Dunham, K. D. Fausch, and M. K. Young. 2008. Analysis of trade-offs between threats of invasion by nonnative brook trout (*Salvelinus fontinalis*) and intentional isolation for native westslope cutthroat trout (*Oncorhynchus clarkii lewisi*). Canadian Journal of Fisheries and Aquatic Sciences 65:557-573.

Pihls, A. 2015. Biological assessment for terrestrial wildlife species for Soda Butte Creek Yellowstone cutthroat trout restoration project. Shoshone National Forest, Cody, Wyoming.

Rojo, A. I. C. Cavada, M. R. de Sagarra, and A. Cuadrado. 2007. Chronic inhalation of rotenone or paraquat does not induce Parkinson's disease symptoms in mice or rats. Experimental Neurology 208:120-126.

Schnick, R. A. 1974. A review of the literature on the use of rotenone in fisheries. USDI Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, LaCrosse, Wisconsin.

Shepard, B. B. 2010. Evidence of niche similarity between cutthroat trout (*Oncorhynchus clarkii*) and brook trout (*Salvelinus fontinalis*): implications for displacement of native cutthroat trout by nonnative brook trout. Doctoral Dissertation, Montana State University, Bozeman, Montana.

Shepard, B. B. and L. Nelson. 2001. Westslope cutthroat trout restoration in Muskrat Creek, Boulder River drainage, Montana: Progress report for period 1993 to 2001. Montana Fish, Wildlife & Parks, Helena, Montana.

Shepard, B. B., L. M. Nelson, M. L. Taper, and A. V. Zale. 2014. Factors influencing successful eradication of nonnative brook trout from four small Rocky Mountain streams using electrofishing. North American Journal of Fish Management.

Shepard, B. B., M. Taper, R. G. White, and S. C. Ireland. 1998. Influence of abiotic and biotic factors on abundance of stream-resident westslope cutthroat Trout Oncorhynchus clarki lewisi in Montana streams. Final report to USDA Forest Service, Rocky Mountain Research Station, Boise, Idaho for contract INT-92682-RJVA. Montana Cooperative Fishery Research Unit, Montana State University, Bozeman.

Skaar, D. 2001. A brief summary of the persistence and toxic effects of rotenone. Montana Fish, Wildlife & Parks, Helena.

Van Goethem, D, B. Barnhart, and S. Fotopoulos. 1981. Mutagenicity studies on rotenone. Report to U. S. Geological Survey. Upper Midwest Environmental Sciences Center (USFWS Study 14-16-009-80-076), La Crosse, Wisconsin

Ware, G. W. 2002. An introduction to insecticides 3rd edition. University of Arizona, Department of Entomology, Tuscon. on EXTOXNET. Extension Toxicology Network. Oregon State University web page.

Werner, J. K., B. A. Maxell, P. Hendricks, and D. L. Flath. 2004. Amphibians and Reptiles of Montana. Mountain Press Publishing Company, Missoula, Montana. 262 pp.

Wohl, N. E. and R. F. Carline. 1996. Relations among riparian grazing, sediment loads, macroinvertebrates, and fishes in three Pennsylvania streams. Canadian Journal of Fisheries and Aquatic Sciences. 53:260-266.